TxDOT
PT/Grout Issues

Brian D. Merrill, P.E.

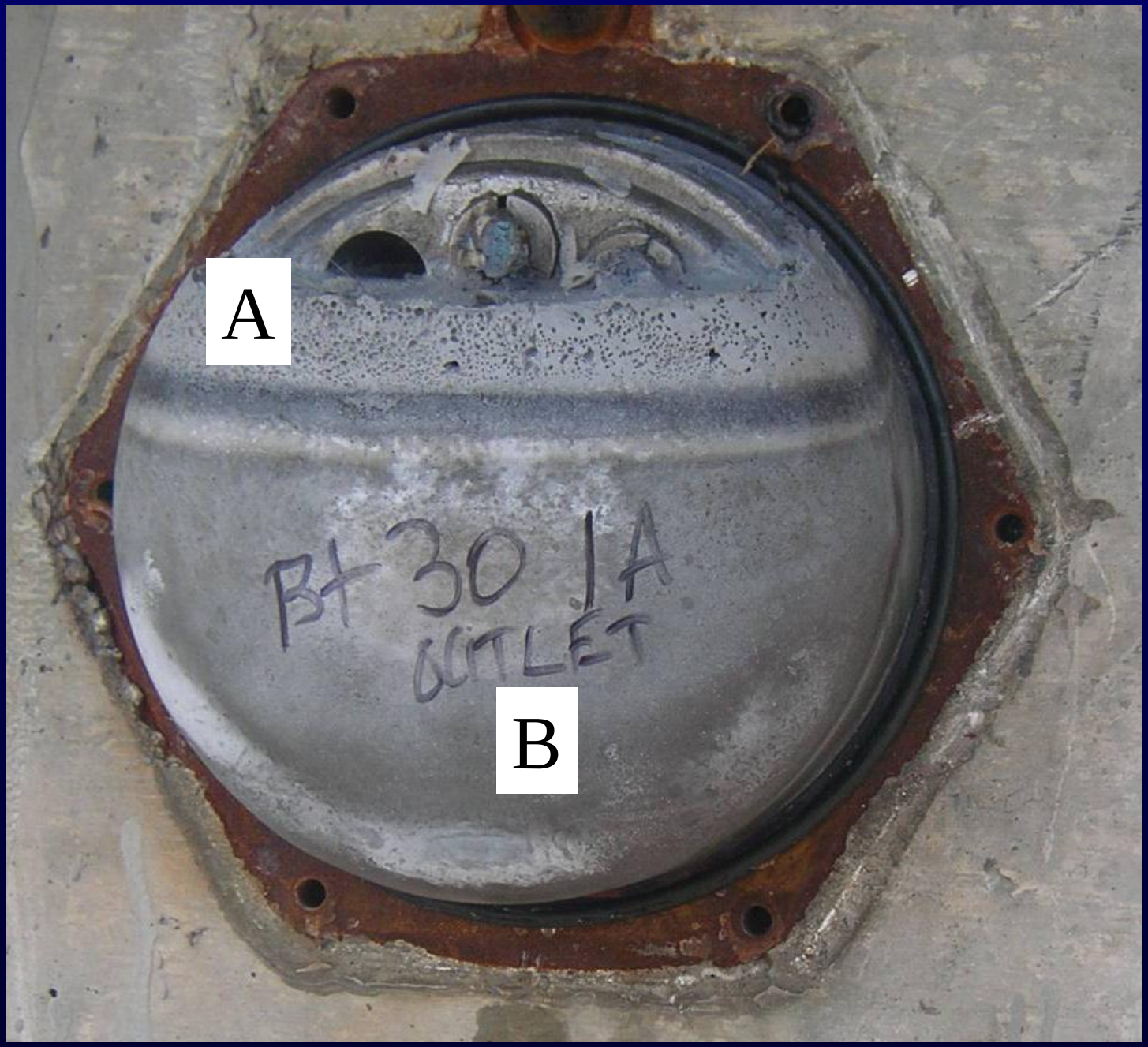
State Bridge Construction &
Maintenance Engineer

PT/Grouting Issues

- Chlorides in Grout
- Soft/segregated grout
- Installation/Inspection issues
- Going forward – Design Issues

Chlorides in Grout

5 bents, 5 tendons per bent , 14-19 strands per tendon


A
B
BT 30 1A
OUTLET

Testing Program

- Optical petrography
  - Significant segregation of “A” material
  - Many large air voids
  - excess moisture present
  - “A” material weak and brittle
  - “B” material appeared normal in strength

Scanning Election Energy Dispersive Spectroscopy/ X-ray Fluorescence/ Ion Chromatography

"A" material

- High levels of Chlorides > 21000 ppm
- High Na and K levels
- Relatively low Ca levels

"B" Material

- Normal hydration
- Cl levels exceed specs (>800 ppm)

Unused grout (dry): approx 1300 ppm of Cl
2nd lot: very low Cl

Contributing factors

- Grout storage
  - Too long (up to 9 months, past shelf life)
  - Too hot (>120F)
- Mixing/pumping issues
- Several blow-outs reported
- Inconsistent procedures
- “burping” tendons
- Pumping pressure/speed

Resolution

- Papers and testimony by Bernd Iseke and Paul Lambert (European corrosion experts)
- Good (“B”) grout presence was verified
- All tendons bore-scoped
- “A” material removed and vacuum grouted
- Conservative design (per code) helped
- Long Term testing paid by supplier (ongoing)

National Issue

- “What starts in Texas changes the world”
- FHWA memo dated 11/23/2011
- ASTM C150: no limits on Cl content in cement
- Most suppliers weren’t testing their cement sources (they are now!)
- Suspect grout produced from 2002 to 2010 – 16M lbs of grout that went to 38 states

Secondary Issues

- Grout segregation
  - Mixing/pumping practices
  - Trapped water in system
  - Pumping pressure
  - Burping

Grout Segregation w/o Chlorides

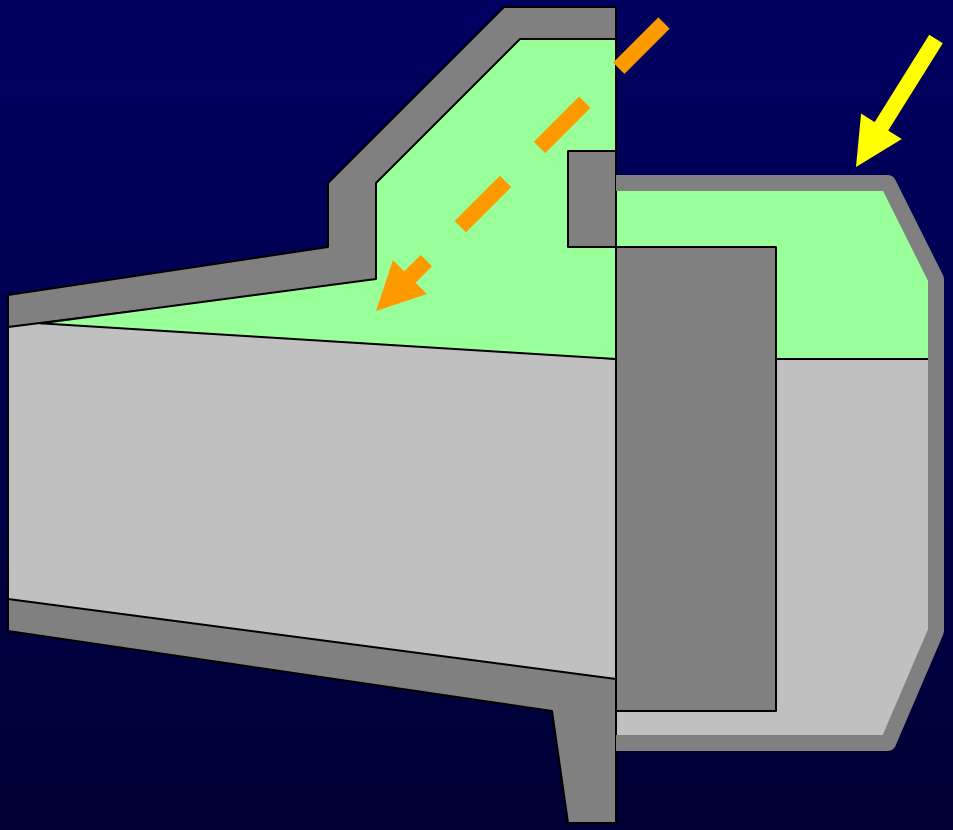
Marble Falls Segmental Bridge

- Diff grout mnfr/grouter
- “gelatinous” grout in top portion
- Segregated
- High concentrations of Na, K, S
- Confined to cap region – did not extend into ducts

Going Forward: Nov 6, 2011 Memo

- Test all grout when on the job – physical and chemical testing
- Watch grout storage: conditions and time
- Restrict pumping pressure/speed
- Disallow burping
- Post-grouting inspection
- 2014 Specs will require PTI certification for all PT operations
- http://ftp.dot.state.tx.us/pub/txdot-info/brg/memos/pt_grouting.pdf

Post-grouting inspection



Will TxDOT use PT?

52 years old
$9M in 1959
$50+M maintenance costs
Will be replaced with segmental bridge ~ 2020

Will TxDOT use PT?

PT Design

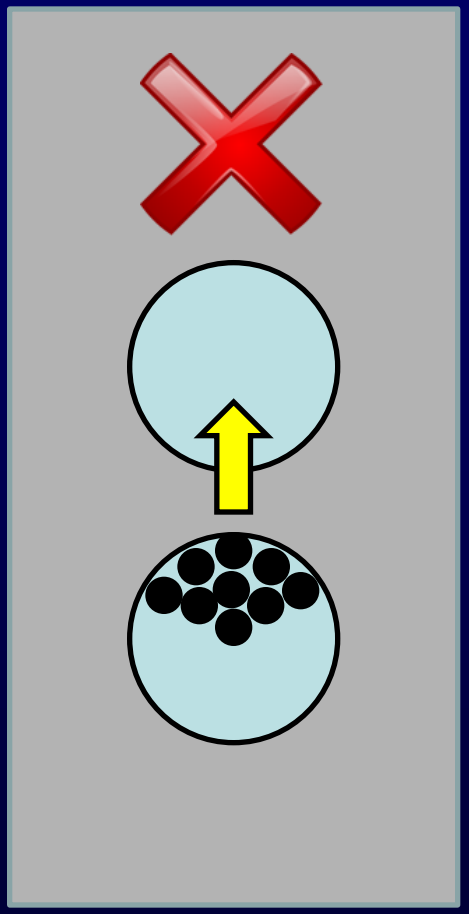
- If ECR is used on the bridge, use Severe Exposure criteria for PT designs
- Plastic ducts are required per Item 426
- Try to use standard tendon sizes/hardware
- Give plenty of room for jacks,…
- Watch stressing sequences
- New PTI Guide Spec coming soon

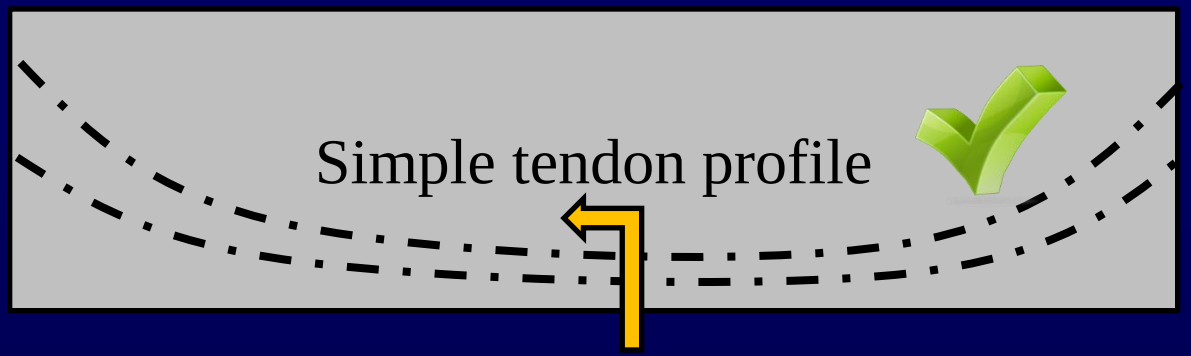
Common Tendon Sizes

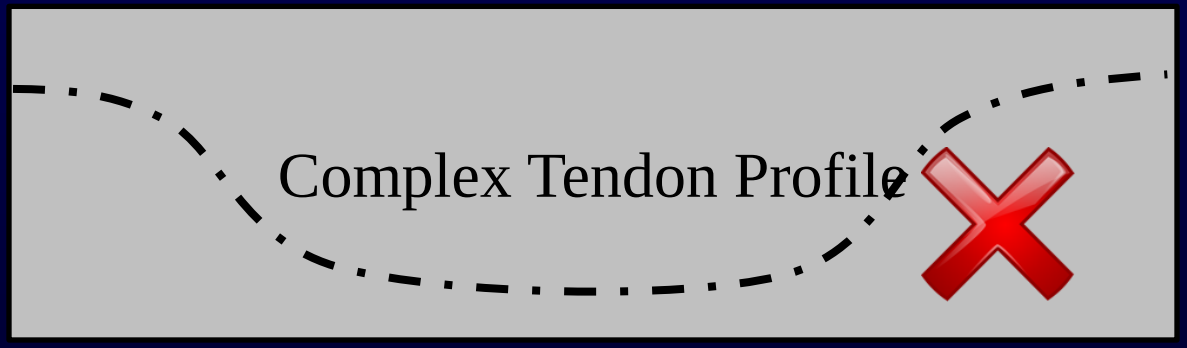
- Mnfr A: 0.5” x 12, 19, 27, 31, 37 strands
  0.6” x 12, 19, 22, 31, 37 strands
- Mnfr B: 0.5” x 9, 12, 15, 27, 37 strands
  0.6” x 9, 12, 15, 19, 27, 37 strands
- Mnfr C: 0.6” x 12, 13, 19,, 22, 25, 27, 31, 37 strands

USE 0.6” x 19

PT Detailing





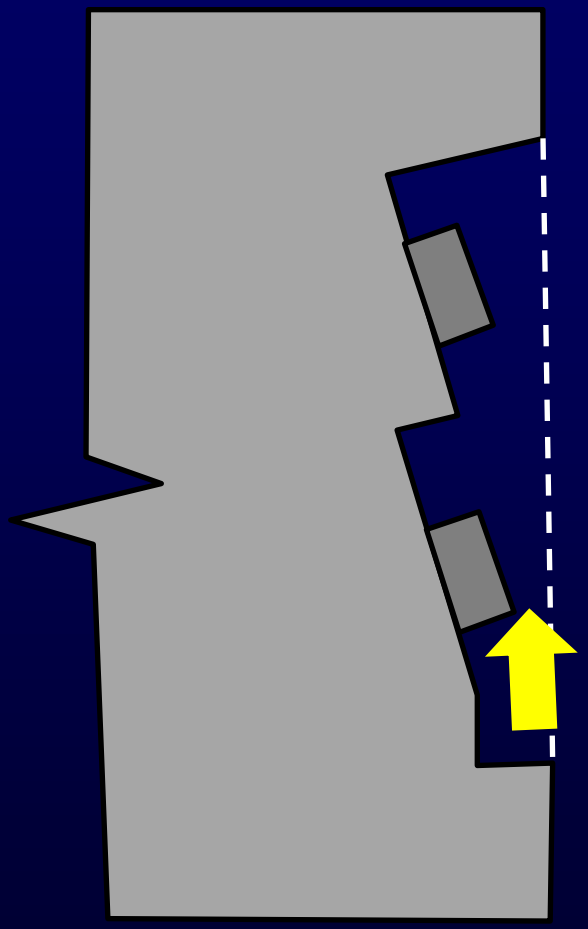


Staged stressing

PT Detailing

- Locate tendons using cg steel
- Give force @ crit location after friction losses
- BRG is working on a PT Standard
  - Will show vent locations,… sim to FDOT
- Show other info (assumed long-term losses) in "Design Notes" on the plans
- Payment – base on force after friction
- Pour-backs

Pour-Backs



Future Specs for PT (2014?)

- Item 426 will be for PT only
- Prestressing will go in 424
- PTI Multi-strand Certification will be required for all operations/installation
- PTI/ASBI Certifications required for grouting